

**B.8 INFILTRATION TRENCHES****DESCRIPTION**

An infiltration trench is basically an excavated trench that has been lined with filter fabric and backfilled with stone to form an underground basin. Runoff is diverted into the trench and either infiltrates into the soil, or enters a perforated pipe underdrain and is routed to an outflow facility. The depths of an infiltration trench generally range between 3 and 8 feet (Schueler, 1987) and may change when site-specific factors are considered. Smaller trenches are used for water quality, while larger trenches can be constructed if stormwater quantity control is required (Schueler, 1987). Trenches are not usually feasible in ultra-urban or retrofit situations where the soils have low permeability or low voids (Schueler, 1992). They should be installed only after the contributing area has stabilized to minimize runoff of sediments.

Infiltration trenches and infiltration basins follow similar design logic. The differences are that the former is for small drainage areas and stores runoff out of sight, within a gravel or aggregate matrix, whereas the latter is for larger drainage areas and water is stored in a visible surface pond.

Infiltration trenches effectively remove soluble and particulate pollutants. They can provide groundwater recharge by diverting 60 to 90 percent of annual urban runoff back into the soil (Boutiette and Duerring, 1994). They are generally used for drainage areas less than 10 acres, but some references cite 5 acres as a maximum size drainage area (Schueler, 1987, 1992). Potential locations include residential lots, commercial areas, parking lots, and adjacent to road shoulders. Trenches are only feasible on permeable soils (sand and gravel), and where the water table and bedrock are situated well below the bottom of the trench (Boutiette and Duerring, 1994; Schueler, 1987). Trenches are frequently used in combination with grassed slopes. Trenches should not be used to trap coarse sediments, because the large sediment will clog the trench. Grass buffers can be installed to capture sediment before it enters the trench.

**ADVANTAGES**

1. Provides groundwater recharge.
2. Trenches fit into small areas.
3. Good pollutant removal capabilities.
4. Can minimize increases in runoff volume.
5. Can fit into medians, perimeters, and other unused areas of a development site.
6. Helps replicate pre-development hydrology and increases dry weather baseflow.

**LIMITATIONS**

1. Slope of contributing watershed needs to be less than 20 percent.
2. Soil should have infiltration rate greater than 0.3 inches per hour and clay content less than 30 percent.
3. Drainage area should be between 1 to 10 acres.
4. The bottom of infiltration trench should be at least 4 feet above the underlying bedrock and the seasonal high water table.
5. High failure rates of conventional trenches and high maintenance burden.
6. Low removal of dissolved pollutants in very coarse soils.
7. Not suitable on fill slopes or steep slopes.
8. Risk of groundwater contamination in very coarse soils, may require groundwater monitoring.
9. Infiltration facilities could fall under Chapter 15, Title 23, of California Code of Regulations regarding waste disposal to land.
10. Cannot be located within 100 feet of drinking water wells.
11. Need to be located a minimum of 10 feet down gradient and 100 feet up gradient from building foundations because of seepage problems.
12. Should not be used if upstream sediment load cannot be controlled prior to entry into the trench.
13. Metals and petroleum hydrocarbons could accumulate in soils to potentially toxic levels.

**DESIGN CRITERIA**

Infiltration trenches can be categorized both by trench type, and as surface or below ground. Special inlets are required for underground trenches to prevent sediment and oil or grease from clogging the infiltration trench (Schueler, 1987). Surface trenches are commonly used where land is not limiting and underground trenches are better suited for development with minimal land availabilities.

1. *Volume.* Calculate the volume of stormwater to be mitigated by the infiltration trench using the Los Angeles County Department of Public Works *Method for Calculating Standard Urban Stormwater Mitigation Plan (SUSMP) Flow Rates and Volumes Based on 0.75-inches of Rainfall*.
2. *Dimensions.* Generally, soils with low infiltration rates require a higher ratio of bottom surface area to storage volume (Northern Virginia Planning District Commission and Engineers and Surveyors Institute, 1992). The following formulas can be used to determine the dimensions of the infiltration basin:

$$H_{Tmax} = \frac{E \times t_{max}}{P}$$

$$H_{Tmin} = \frac{E \times t_{min}}{P}$$

$$A = \frac{V}{E \times t_{max}}$$

Where:

$H_{Tmax}, H_{Tmin}$	=	Maximum and minimum trench depths (ft).
$E$	=	Infiltration rate in length per unit time (ft/hr).
$t_{max}, t_{min}$	=	Maximum and minimum target drain-time (hr).
$P$	=	Pore volume ratio of stone aggregate (% porosity/100).
$V$	=	Fluid storage volume requirement (ft <sup>3</sup> ).
$A$	=	Trench bottom surface area (ft <sup>2</sup> ).

The actual storage volume of the facility is the void ratio multiplied by the total volume of the trench. The available land and other constraints such as depth to bedrock or water table are used to determine the final dimensions of the trench.

3. **Buffer Strip/Special Inlet.** A grass filter strip a minimum of 20 feet should surround the trench on all sides over which surface flow reaches an above-ground trench. A special inlet can be used to prevent floatable material, solids, grease, and oil from entering trenches which are located below ground.
4. **Filter Fabric.** The bottom and sides of the trench should be lined with filter fabric soon after the trench is excavated. The fabric should be flush with the sides, overlap on the order of 2 feet over the seams, and not have trapped air pockets. As an alternative, 6 inches of clean, washed sand may be placed on the bottom of the trench instead of filter fabric.
5. **Grass Cover.** If the trench is grass covered, at least 1 foot of soil should be over the trench for grass substrate.
6. **Surface Area.** The surface area of the trench can be engineered to the site with the understanding that a larger surface area of the bottom of the trench increases

infiltration rates and helps to reduce clogging and that depth may be limited by seasonal groundwater.

7. *Surface Area of the Trench Bottom.* Pollutant removal in a trench can be improved by increasing the surface area of the trench bottom. This is done by adjusting the geometry to make the trench shallow and broad, rather than deep and narrow. Greater bottom surface area increases infiltration rates and provides more area and depth for soil filtering. In addition, broader trench bottoms reduce the risk of clogging at the soil/filter cloth interface by spreading infiltration over a wider area.
8. *Distance from Wells and Foundations.* The trench should be at least 100 feet of any drinking water supply well, and at least 10 feet downgradient and 100 feet upgradient from building foundations (Schueler, 1987).
9. *Drain Time.* The drain time should be between two and three days. The total volume of the trench should drain in 48 hours. The minimum drain time should be 24 hours.
10. *Backfill Material.* The backfill material in the trench should have a  $D_{50}$  sized between 1.5 and 3 inches and clay content should be limited to less than 30 percent. The porosity of the material should be between 0.3 and 0.4.
11. *Observation Well.* An observation well of 4 to 6 inches diameter PVC should be located in the center of the trench and the bottom should rest on a plate. The top should be capped. The water level should be measured after a storm event. If it has not completely drained in three days, some remedial work may need to be done.
12. *Overflow Berm.* A 2 to 3 inch emergency overflow berm on the downstream side of the trench serves a twofold purpose. First, it detains surface runoff and allows it to pond and infiltrate to the trench. The berm also promotes uniform sheet flow for runoff overflow.

## **V. REFERENCES**

1. L. N. Boutiette and C. L. Duerring, 1994. *Massachusetts Nonpoint Source Management Manual, The Megamanual: A Guidance Document for Municipal Officials*, Massachusetts Department of Environmental Protection, Office of Watershed Management, Nonpoint Source Program, Boston, MA.
2. Camp, Dresser and McKee, Inc., Larry Walker Associates, 1993. *California Best Management Practices - Municipal*, California State Water Resources Council Board, Alameda, CA.
3. DEQ Storm Water Management Guidelines, Department of Environmental Quality, State of Oregon. <http://waterquality.deq.state.or.us/wq/groundwa/swmgmtguide.htm>
4. M. E. Dormann, J. Hartigan, and B. Maestri, 1988. *Retention, Detention, and*

*Overland Flow for Pollutant Removal from Highway Stormwater Runoff: Interim Guidelines for Management Measures*, FHWA/RD-87/056, Federal Highway Administration, Versar, Inc., Springfield, VA.

5. GKY and Associates, Inc. June 1996. *Evaluation and Management of Highway Runoff Water Quality*, Publication No. FHWA-PD-96-032. Prepared for: US Department of Transportation, Federal Highway Administration. Washington, DC.
6. *Low-Impact Development Design Manual*, November 1997. Department of Environmental Resources, Prince George's County, MD.
7. Northern Virginia Planning District Commission and Engineers Surveyors Institute, 1992. *Northern Virginia BMP Handbook, A Guide to Planning and Designing Best Management Practices in Northern Virginia*, Annandale, VA.
8. T. R. Schueler, 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, Department of Environmental Programs, Metropolitan Washington Council of Governments, Washington, DC.
9. T. R. Schueler, P. Kumble, and M. Heraty, 1992. *A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone*, Anacostia Research Team, Metropolitan Washington Council of Governments, Washington, DC.
10. Ventura Countywide Stormwater Quality Management Program, *Draft BMP IN: Infiltration Facilities*, June 1999. Ventura, CA.